

Amendments to the Claims

The following listing of claims will replace all prior versions, and listings, of claims in this Patent Application:

1. (currently amended) An apparatus for precisely and reliably assembling a critical joint, comprising:

a thread-forming fastener including a head for engagement by a tool for applying a torque to the fastener, and a body portion extending from the head and including thread-forming portions; and

an ultrasonic transducer coupled with the thread-forming fastener, for making precise and reliable ultrasonic load measurements in the thread-forming fastener.

2. (currently amended) The apparatus of claim 1 wherein the ultrasonic transducer is coupled with the head of the thread-forming fastener.

3. (currently amended) The apparatus of claim 1 wherein the ultrasonic transducer is permanently attached to the thread-forming fastener.

4. (currently amended) The apparatus of claim 3 wherein the ultrasonic transducer is comprised of a

piezoelectric polymer film permanently attached to the head of the thread-forming fastener.

5. (currently amended) The apparatus of claim 3 wherein the ultrasonic transducer is comprised of an oriented piezoelectric thin film, vapor deposited directly on the head of the thread-forming fastener.

6. (currently amended) The apparatus of claim 3 wherein the ultrasonic transducer is chemically grafted on the head of the thread-forming fastener.

7. (currently amended) The apparatus of claim 1 wherein the ultrasonic transducer is temporarily attached to the thread-forming fastener.

8. (currently amended) The apparatus of claim 1 wherein the ultrasonic transducer further includes an information storage medium applied to the ultrasonic transducer, wherein the information storage medium includes markings corresponding to data associated with the thread-forming fastener.

9. (previously presented) The apparatus of claim 8 wherein the information storage medium is a bar code applied to the ultrasonic transducer.

10. (currently amended) A method of making a load indicating, thread-forming fastener for precisely and reliably assembling a critical joint, comprising the steps of:

providing a thread-forming fastener having a first end including a surface for receiving an ultrasonic transducer, for making ultrasonic load measurements in the fastener, a shank extending from the first end and including thread-forming portions for tapping a hole, and a second end, opposite the first end and including a surface for reflecting an ultrasonic wave back to the first end; and

attaching an ultrasonic transducer for making precise and reliable ultrasonic load measurements in the thread-forming fastener to the first end of the thread-forming fastener.

11. (currently amended) The method of claim 10 which further includes the step of attaching the ultrasonic transducer to a head associated with the first end of the thread-forming fastener, for engagement by a tool for applying a torque to the thread-forming fastener.

12. (currently amended) The method of claim 10 which further includes the step of permanently attaching the ultrasonic transducer to the thread-forming fastener.

13. (currently amended) The method of claim 12 which

further includes the step of permanently attaching an ultrasonic transducer comprised of a piezoelectric polymer film to the first end of the thread-forming fastener.

14. (currently amended) The method of claim 12 which further includes the step of vapor depositing an ultrasonic transducer comprised of an oriented piezoelectric thin film directly onto the first end of the thread-forming fastener.

15. (currently amended) The method of claim 12 which further includes the step of chemically grafting an ultrasonic transducer onto the first end of the thread-forming fastener.

16. (currently amended) The method of claim 10 which further includes the step of temporarily attaching the ultrasonic transducer to the thread-forming fastener.

17. (currently amended) The method of claim 10 which further includes the step of applying an information storage medium to the ultrasonic transducer, wherein the information storage medium includes markings corresponding to data associated with the thread-forming fastener.

18. (previously presented) The method of claim 17 which further includes the step of applying a bar code to the

ultrasonic transducer.

19. (withdrawn - currently amended) A method of measuring a load in a fastener, comprising the steps of:

providing a thread-forming fastener including a head for engagement by a tool for applying a torque to the fastener, and a body portion extending from the head and including thread-forming portions;

coupling an ultrasonic transducer with the thread-forming fastener, for making ultrasonic load measurements in the thread-forming fastener;

electrically connecting an apparatus to the ultrasonic transducer for supplying signals to the ultrasonic transducer and for receiving signals from the ultrasonic transducer;

monitoring the signals received from the ultrasonic transducer, providing an accurate measurement indicative of the load in the thread-forming fastener; and

adjusting the measurement indicative of the load to compensate for effects of heating of the thread-forming fastener resulting from forming a thread in a mating component during installation.

20. (withdrawn - currently amended) The method of claim 19 which further includes the step of imparting torque

to the thread-forming fastener and removing torque from the thread-forming fastener in response to the measurement of the load in the thread-forming fastener.

21. (withdrawn - currently amended) The method of claim 19 which further includes the step of determining a zero-load ultrasonic measurement, using the measurement indicative of the load in the thread-forming fastener.

22. (withdrawn - currently amended) The method of claim 21 which further includes the step of measuring a torque in conjunction with the measurement indicative of the load in the thread-forming fastener to determine the zero-load ultrasonic measurement.

23. (withdrawn - currently amended) The method of claim 21 which further includes the step of measuring an angle of rotation of the thread-forming fastener in conjunction with the measurement indicative of the load in the thread-forming fastener to determine the zero-load ultrasonic measurement.

24. (withdrawn - currently amended) The method of claim 21 which further includes the step of measuring time in conjunction with the measurement indicative of the load in the thread-forming fastener to determine the zero-load ultrasonic

measurement.

25. (withdrawn) The method of claim 21 which further includes the step of taking measurements for determining the zero-load ultrasonic measurement prior to a load-inducing stage of the installation.

26. (withdrawn) The method of claim 21 which further includes the step of taking measurements for determining the zero-load ultrasonic measurement during a load-inducing stage of the installation.

27. (withdrawn - currently amended) The method of claim 19 which further includes the step of placing markings on the ultrasonic transducer corresponding to data associated with the thread-forming fastener.

28. (withdrawn) The method of claim 27 which further includes the step of marking a bar code on the ultrasonic transducer.

29. (withdrawn - currently amended) A method of measuring a load in a fastener, comprising the steps of:
providing a thread-locking fastener assembly
~~including a bolt having a head~~ for engagement by a tool

for applying a torque to the thread-locking fastener assembly, including a bolt having a head and a body portion extending from the head, and a nut for cooperating with the body portion of the bolt, wherein portions of the thread-locking fastener assembly include resistance-inducing threads;

coupling an ultrasonic transducer with the bolt, for making ultrasonic load measurements in the thread-locking fastener assembly;

electrically connecting an apparatus to the ultrasonic transducer for supplying signals to the ultrasonic transducer and for receiving signals from the ultrasonic transducer;

monitoring the signals received from the ultrasonic transducer, providing an accurate measurement indicative of the load in the thread-locking fastener assembly; and

adjusting the measurement indicative of the load to compensate for effects of heating of the thread-locking fastener assembly resulting from prevailing torque associated with the thread-locking fastener assembly.

30. (withdrawn - currently amended) The method of claim 29 which further includes the step of imparting torque to the assembly [[bolt]] and removing torque from the assembly [[bolt]] in response to the measurement of the load in the thread-locking fastener assembly.

31. (withdrawn - currently amended) The method of claim 29 which further includes the step of determining a zero-load ultrasonic measurement, using the measurement indicative of the load in the thread-locking fastener assembly.

32. (withdrawn - currently amended) The method of claim 31 which further includes the step of measuring a torque in conjunction with the measurement indicative of the load in the thread-locking fastener assembly to determine the zero-load ultrasonic measurement.

33. (withdrawn - currently amended) The method of claim 31 which further includes the step of measuring an angle of rotation of the fastener in conjunction with the measurement indicative of the load in the thread-locking fastener assembly to determine the zero-load ultrasonic measurement.

34. (withdrawn - currently amended) The method of claim 31 which further includes the step of measuring time in conjunction with the measurement indicative of the load in the thread-locking fastener assembly to determine the zero-load ultrasonic measurement.

35. (withdrawn - currently amended) The method of claim 31 which further includes the step of taking measurements

for determining the zero-load ultrasonic measurement prior to inducing the load in the thread-locking fastener assembly.

36. (withdrawn - currently amended) The method of claim 31 which further includes the step of taking measurements for determining the zero-load ultrasonic measurement while inducing the load in the thread-locking fastener assembly.

37. (withdrawn - currently amended) The method of claim 29 which further includes the step of placing markings on the ultrasonic transducer corresponding to data associated with the thread-locking fastener assembly.

38. (withdrawn) The method of claim 37 which further includes the step of marking a bar code on the ultrasonic transducer.

39. (currently amended) The apparatus of claim 1, in combination with a load measurement apparatus for making ultrasonic load measurements in the thread-forming fastener, wherein the load measurement apparatus is electrically connected to the ultrasonic transducer to supply for supplying signals to the ultrasonic transducer and to receive for receiving signals from the ultrasonic transducer, and includes a monitor receiving ~~wherein the signals received from the ultrasonic transducer are~~

~~monitored~~ to provide an accurate measurement indicative of the load in the thread-forming fastener, and a compensator adjusting ~~wherein~~ the measurement indicative of the load ~~is adjusted~~ to compensate for effects of heating of the thread-forming fastener resulting from forming a thread in a mating component during installation.

40. (currently amended) The apparatus of claim 39 wherein the load measurement apparatus is coupled with a tool for engaging the head of the thread-forming fastener, and wherein the tool imparts torque to the thread-forming fastener and removes torque from the thread-forming fastener responsive to the measurement of the load in the thread-forming fastener.

41. (currently amended) The apparatus of claim 39 wherein the load measurement apparatus determines a zero-load ultrasonic measurement in the thread-forming fastener using the measurement indicative of the load in the thread-forming fastener.

42. (previously presented) The apparatus of claim 41 wherein the load measurement apparatus determines the zero-load ultrasonic measurement prior to a load-inducing stage of the installation.

43. (previously presented) The apparatus of claim 41 wherein the load measurement apparatus determines the zero-load ultrasonic measurement during a load-inducing stage of the installation.

44. (currently amended) The apparatus of claim 39 which further includes markings placed on the ultrasonic transducer which correspond to data associated with the thread-forming fastener.

45. (previously presented) The apparatus of claim 44 wherein the markings are a bar code placed on the ultrasonic transducer.